DSPO PSMC Briefing

Parts, Materials, and Process Mission Assurance Plan (PMAP)

MDA/QSA

Integrated Ballistic Missile Defense System

Sensors

Defense Support Program

Space Tracking And Surveillance System

Sea-Based Radars

Forward-Based Radar

Early Warning Radar

Boost Defense Segment

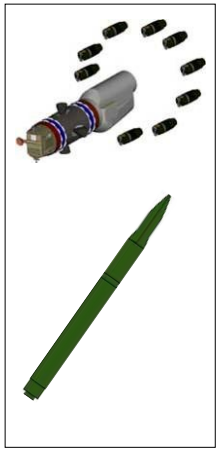
Midcourse Defense Segment

Terminal Defense Segment

Airborne Laser

Kinetic Energy Interceptor

Aegis Ballistic Missile Defense / Standard Missile-3



Multiple Kill Vehicle

Ground-Based Midcourse Defense

Terminal High Altitude Area Defense

Patriot Advanced Capability-3

Command, Control, Battle Management & Communicat

NMCC USSTRATCOM USNORTHCOM USPACOM EUCOM CENTCOM

Why Develop An Agency PMP Plan?

- **Parts, Materials and Processes form the basic building blocks of the system**
  - **Inherent reliability of hardware is dependent upon reliability of Parts, Materials and Processes**
- **QS Mission Assurance audits and NSWC Crane analysis identified variability in each MDA Element's approach to PMP management**
  - **Electrical, Electronic and Electromechanical (EEE) part selection, procurement, usage, and qualification**
  - **EEE part derating, COTS suitability, Plastic Encapsulated Microcircuits (PEMS)**
  - **Prohibited parts and materials, subcontractor flow down of PMP requirements**
- **Higher than expected percentage of MDA audit findings were PMP related**
- **Wide variety of application environments:**
  - **Space, Interceptors, Airborne, Sea- & Land-based Rugged, Ground**
- **PMAP further defines the PMP requirements of the MAP**

ariety of MDA Programs requires PMP application gui
The PMAP

Why Not use an existing PMP Standard?

- **MIL-HDBK-965, Acquisition Practices for Parts Management was cancelled without replacement, 4 October 2000**

- **MIL-HDBK-512, Parts Management Handbook focuses on parts standardization and does not address Parts Review Board or technical requirements**

- **ANSI/AIAA – R-100A-2001, generic specification for a Parts Management Program aimed towards Parts Program evaluation (checklists)**

- **Aerospace Corporation is planning to publish TOR-2006(8583)-5235, Parts, Materials, and Processes Control Program for Space and Launch Vehicles to replace MIL-STD-1546 later this calendar year. This document utilizes a Parts Review Board but focuses on Space and Launch Vehicles only**

ustry Standard for PMP exists that will address all MDA Applications

PMAP Executive Summary

- **<u>Scope</u>: Applies to new or modified safety and mission critical systems throughout the complete product life cycle: design, development, fabrication, operation and obsolescence**

- **<u>Applicability</u>: All programs providing safety and mission critical systems, including C2BMC**

- **<u>Requirements</u> are tailored for each asset using categories that vary depending on environment and period of use, e.g. space, sea-based, ground-based.**

PMAP Business Model

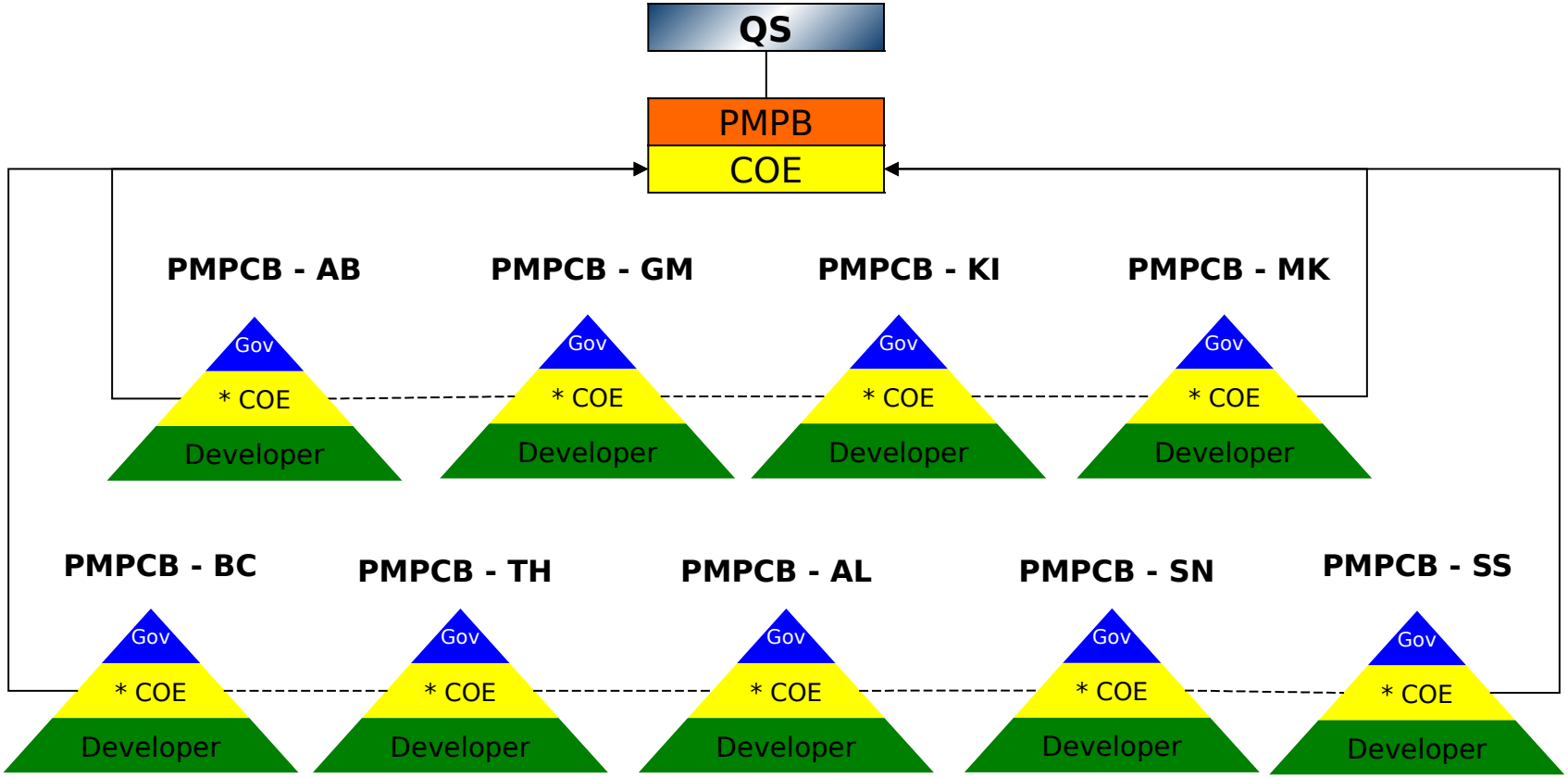
- **Business case employed is to establish a PMP Center of Excellence and Review Board at the Agency level**
- **All COE and PMPB personnel funded at the Agency level**
- **Center of Excellence established to perform the following:**
  - **Provide commodity experts to support the MDA Program Offices**
    - **Microcircuits, Semiconductors, Connectors, Passive devices, Hybrids, RF components, Memory devices, Materials, Mechanical parts, Wire, Magnetics, Rad hard, Lead Free, Corrosion, COTS assemblies,**
  - **Provide Agency level participation in Government/Industry Working Groups such as:**
    - **EIA- Electronic Industries Alliance**
    - **JEDEC- Joint Electron Device Engineering Council**
    - **GEIA – Government Electronics and Information Association**
    - **IPC – Institute for Interconnecting and Packaging Electronic Circuits**
    - **DSPO – Defense Standardization Program Office**
    - **CALCE – University of Maryland Center for Advanced Life Cycle Engineering**
  - **Supports Failure Review Boards and reviews PMP Deviations and Waivers**
- **No intent to create another expensive DOD facility**
  - **Use existing expertise at NSWC-Crane & US ARMY AMRDEC Huntsville**

What is defined in the PMAP?

- **Establishes the requirements for both Agency and Program Office parts and materials Control Boards**
  - **MDA PMPB Chairman reports to the MDA QS director**
  - **Ensures all Program Office Boards are consistent in applying requirements**
- **Creates a Center of Excellence for in-depth technical expertise and labs**
- **Comprehensive section on PMP requirements**
  - **PMP selection, procurement, qualification, screening, derating, rad hard, custom devices, corrosion prevention, PEM requirements, environmental controls, DPA**
- **Establishes direction and control of intra Agency PMP activity**
  - **Maintains Agency wide approved Parts and Materials, and Prohibited Parts and Materials Lists**
  - **Works with industry to develop and characterize new technologies**
  - **Ensures the proper PMP resources exist within each Program Office**
  - **Disseminates GIDEP and MDA Advisory process**
  - **Keeps MDA-wide PMP issues and resolutions information base**
  - **Management of Obsolescence**

MPB provides oversight of element boards and shar

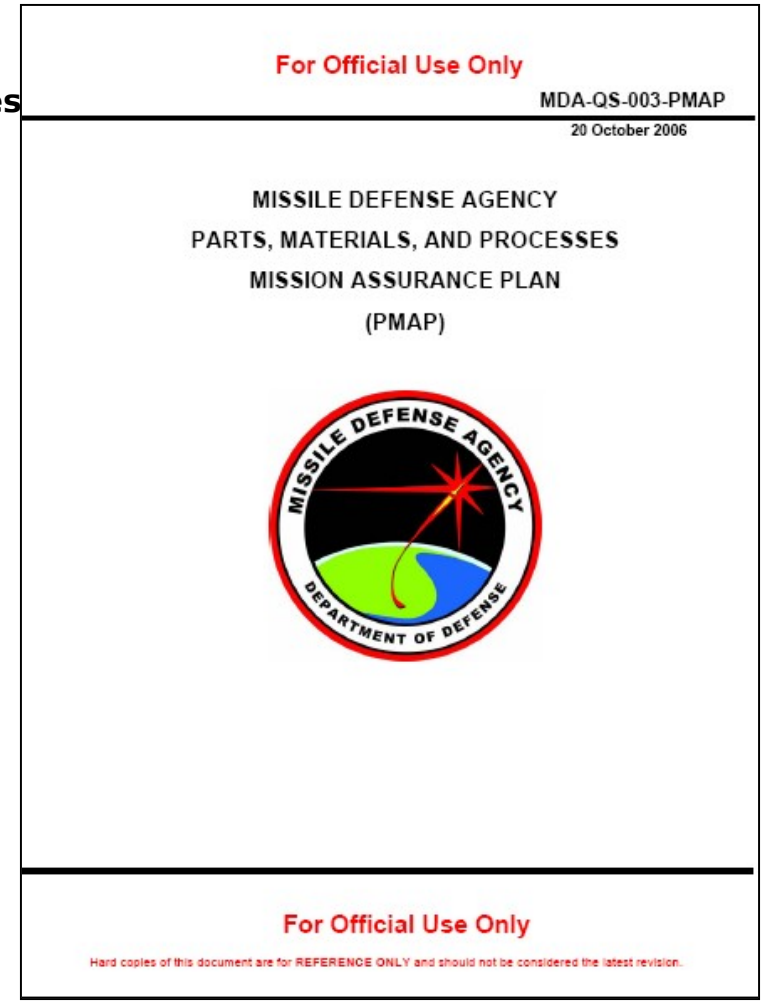
Proposed MDA PMP Board Construct



* COE resources shared across all programs to ensure uniformity

PMAP Contents

- **Applicable Documents (References)**
  Government and Commercial
- **PMP Management Structure, Roles, and Responsibilities**
  PMP Board, PMP Control Board, COE
- **PMP Requirements**
  EEE Parts
  Materials
  Corrosion Prevention
  Prohibited Parts and Materials
  PMP Quality Requirements
  PMP Procurement Management
  Radiation Hardness Assurance
  Government Furnished Equipment and Material
  PMP Qualification
  COTS Management
  Non-Conforming
  Failure Analysis
  ESD
  Environmental Controls
  Handling
  Preservation, Packaging and Storage
- **Appendices**
  Derating
  PEM
  COTS
  Radiation Hardness Assurance
  Prohibited Items Requiring Special Consideration
  PMAP Data Items
  Corrosion
  PMAP Compliance Matrix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MDA-QS-003-PMAP
20 October 2006
MISSILE DEFENSE AGENCY
PARTS, MATERIALS, AND PROCESSES
MISSION ASSURANCE PLAN
(PMAP)
MISSILE DEFENSE AGENCY
DEPARTMENT OF DEFENSE
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Parts Screened for Application

3.2 Hardware Categories and Definitions

Category A: Continuous use systems, under space environment conditions, non-repairable, such as satellite systems that encounter severe environment conditions from launch, flight trajectory and orbit. System flow-down radiation hardness requirements (low dose rate, high total dose) must be satisfied. Category A mission application includes STSS and DSP.

Category B: Impulse (Single shot) systems encountering extreme conditions related to launch (air, ground and sea), flight trajectory, vehicle boost into exo-atmosphere, and vehicle reentry. Category B hardware can be subjected to periods of long term storage. Once deployed, equipment is non-repairable. System flow-down radiation hardness requirements (possible high dose rate, low total dose) must be satisfied. Category B mission application includes SM3, THAAD, KI, EKV, MKV, GBI, etc.

Category C: Extended use aircraft systems, intermittent use sensors, non-repairable in field, and occupied by an air crew. Equipment exposed to turbulence and air temperature fluctuations. Extreme pressure, shock, and vibration are minimal. Category C mission application includes long mission aircraft such as Airborne Laser.

Category D: Ground and Sea-based systems (mobile/stationary), repairable, exposed to one or more of the following: temperature and humidity fluctuations, vibration, shock, and Electromagnetic Environmental Effects. Category D mission application includes ground and sea-based missile support equipment, launchers, ground sensors, sea-based sensors, command and control, combat systems, and field test equipment.

Category E: Ground systems (stationary), repairable, in temperature and humidity controlled environments readily accessible to maintenance. Category E mission application includes C2BMC, facility test equipment, and computer complexes. Hardware in this category is typically used in 24/7 systems.

PMAP defines 5 Program categories

- **Specific quality levels required for categories A –E**
- **All EEE parts shall be screened to ensure they meet or exceed application requirements**

Table 2. Minimum Quality/Failure Rate Level for EEE Parts

Quality Level (Class) or Failure Rate Levels (FRL)							
Part	Cat A	Cat B	Cat C	Cat D	Cat E	Reference Specification	
Microcircuits	V	Q 4/	Q or N	Q or N	Commercial	MIL-PRF-38535 1/	
Hybrid Microcircuits	K	H	H	H	Commercial	MIL-PRF-38534	
Discrete Semiconductors	JANS	JANTXV, JANTX	JANTX	JANTX	Commercial	MIL-PRF-19500 1/	
Capacitors, Established Reliability (ER)	S	R	R	P	Commercial	**Ceramic** - MIL-PRF-20 - MIL-PRF-123 - MIL-PRF-39014 - MIL-PRF-55681 - MIL-PRF-49470	**Tantalum** - MIL-PRF-39003 2/ - MIL-PRF-39006 - MIL-PRF-55365 2/
						Glass - MIL-PRF-23269	**Plastic** - MIL-PRF-83421 - MIL-PRF-87217
Capacitor (non-ER)	Mil	Mil	Mil	Mil	Commercial	**High Voltage** - MIL-PRF-49467	
Resistors (ER)	T	R	R	P	Commercial	**Film** - MIL-PRF-39017 - MIL-PRF-55182 - MIL-PRF-55342	**Wirewound** - MIL-PRF-39005 - MIL-PRF-39007 - MIL-PRF-39015
						Power - MIL-PRF-39009	**Network** - MIL-PRF-83401
Resistors (non-ER)	Mil	Mil	Mil	Mil	Commercial	**High Voltage:** MIL-PRF-49462	
Coils, Molded (ER)	T	R	R	P	Commercial	MIL-PRF-39010	
Coils, Molded (non-ER)	Mil	Mil	Mil	Mil	Commercial	MIL-PRF-83446	
Magnetics	S 3/	T	T	M	Commercial	MIL-PRF-27, MIL-PRF-21038, MIL-STD-981	
Relays (ER)	R	R	R	P	Commercial	MIL-PRF-39016	
Crystals	Mil	Mil	Mil	Mil	Commercial	MIL-PRF-3098	
Crystal Oscillator	Class S	Class B	Class B	Class B	Commercial	MIL-PRF-55310	
Connectors	Mil	Mil	Mil	Mil	Commercial	MIL-DTL-38999, MIL-DTL-24308, MIL-DTL-83513, MIL-DTL-55302, MIL-PRF-39012	
Filters	S	B	B	B	Commercial	MIL-PRF-28861, MIL-PRF-15733	
Fuses	Mil	Mil	Mil	Mil	Commercial	MIL-PRF-23419	
Switches	Mil	Mil	Mil	Mil	Commercial	MIL-PRF-8805, MIL-PRF-24236	
Thermistors	Mil	Mil	Mil	Mil	Commercial	MIL-PRF-23648	
Wire and Cable	Mil	Mil	Mil	Mil	Commercial	MIL-W-22759, MIL-W-81044, MIL-C-17	

EEE Screening Philosophy

PMAP screening requirements ensures that evolving threats

using the latest technology can be countered (ensures reliability

using proven methods)

- **Use of standard military parts with proven reliability when available**
- **Allows for the use of emerging technologies through**

…upscreening

…qualifying for application environment or

…repackaging for “High-Rel” performance

Facilitate the use of emerging technologies in High-Rel MDA applicatio

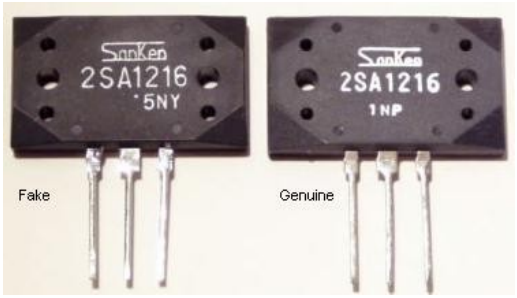
Counterfeit Components

- **Illicit operators produce fake parts, selling cheap or defective devices as more expensive name brand devices**
  - **Buy low-power die, put in high-power packages.**
  - **Relabel cheaper parts as more expensive part number.**
  - **Build parts from scratch to substandard processes.**
  - **Dumpster Diving, Backdoor Collection – Taking bad parts discarded during OEM screening and selling to unsuspecting distributors as “good”.**
- **China is the primary source of counterfeit parts**
  - **Produces 1 to 10 billion $ in counterfeit parts per year (various estimates).**
  - **Portion of world-wide IC fabrication is rising, 35% by 2010.**
  - **Rapid expansion of fab sites, little government control.**
- **Companies counterfeited include Motorola, On Semi, Toshiba, National, PMC-Sierra, Maxim, Linear Tech, etc. Any of the “majors” is vulnerable**
- **MDA GMD recently encountered a counterfeit op-amp purchased through an unauthorized distributor**

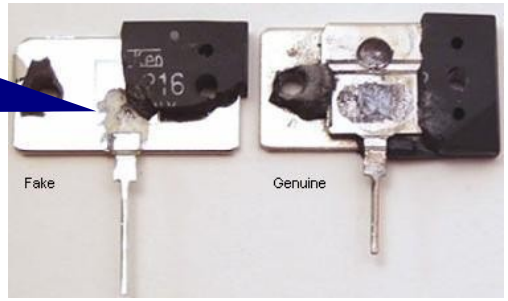
Counterfeit Components (Examples)

Counterfeit capacitors with substandard electrolyte

Counterfeit Genuine



Fake vs genuine. Note the difference in die size after de-capsulation



Counterfeit Genuine

Note the difference in component marking. This one, from PMC-Sierra, shows faked company symbol, including scratches where original marking was removed

PMAP Combating Counterfeits

- **PMAP 3.7.1 Supplier/Vendor Selection:**
  PMAP Parts and materials shall not be purchased through distributors or brokers unless there is no other means for procurement. When parts or materials must be purchased from a distributor or broker, only developer certified or franchised distributors shall be used.

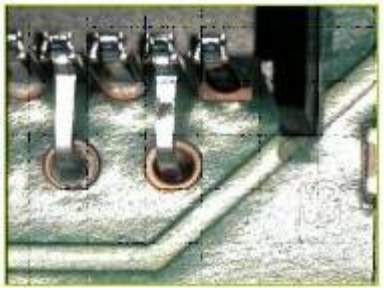
- **PMAP 3.6.8 Counterfeit Parts and Materials**
  When a counterfeit part is identified through electrical testing, DPA, X-Ray, or any means, the developer shall complete the following:
  1. Immediately impound the part and/or material and all others in the procurement lot
  2. Verify the procurement source and associated certifying paperwork
  3. Perform sufficient testing to verify the device and/or material is counterfeit
  4. Notify the developer's legal office and the MDA PMPB
  5. Contact manufacturer that was counterfeited and distributor if applicable
  6. Initiate a MDA Assurance Advisory documenting details of nonconformance
- **PMAP 3.6.9 Destructive Physical Analysis**
  For Space and Interceptor hardware, DPA shall be performed on 1 EEE device per lot date code

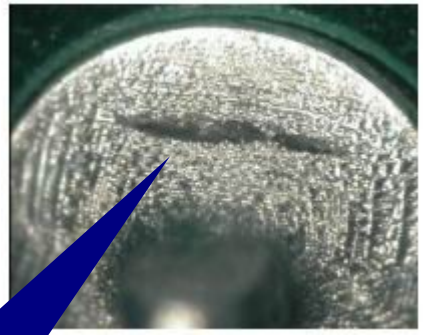
Lead Free Solder Issues

Poor wetting on SOIC

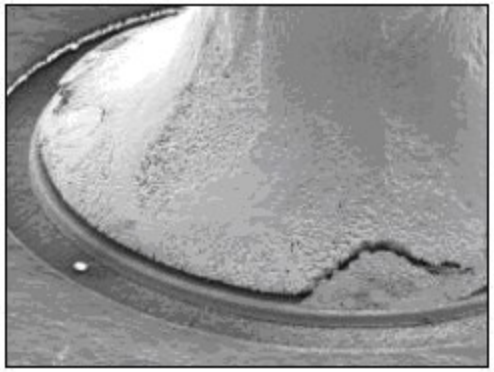
"Icicling" caused by low Pb-free solder temp

Poor hole fill from inadequate solder flow



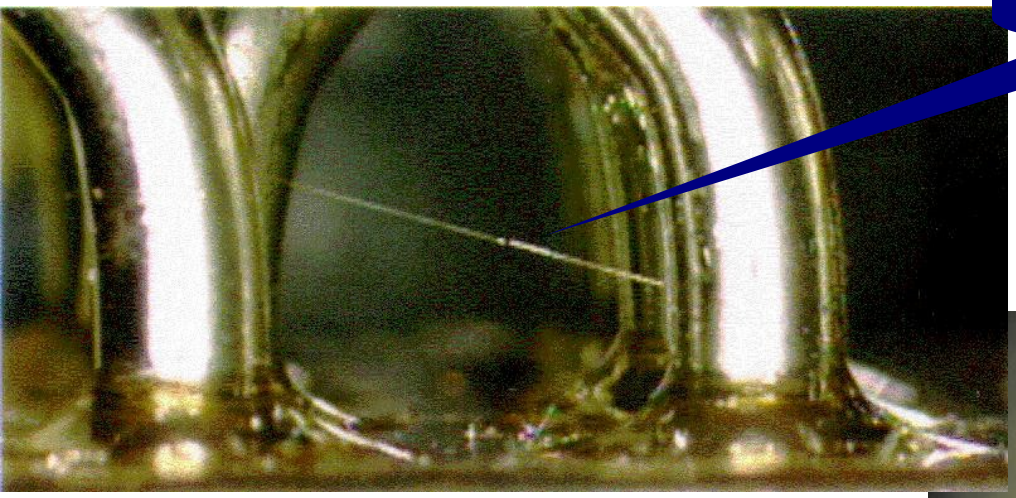


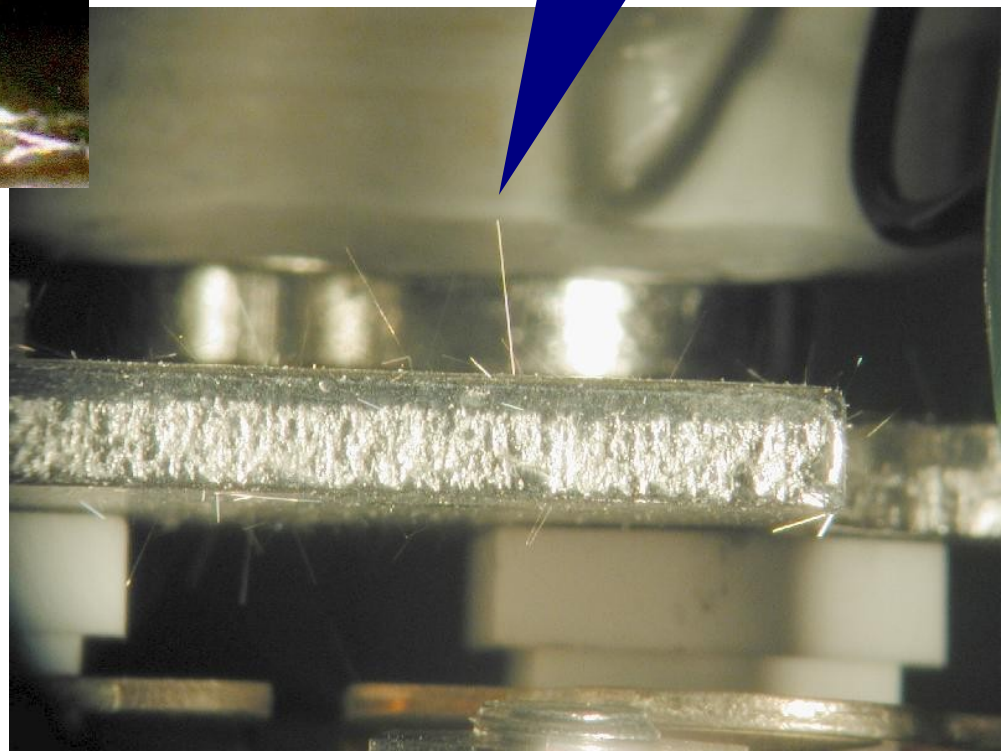
Pb-free solder "tearing"



Fillet lifting and cracking (brittleness)

Tin Whisker Problem





Pure tin plating and pure tin solders can form whiskers between conductors over time, creates shorts.

PMAP Combating Lead Free Risks

- **PMAP 3.2.8 Lead-Free Solder Alloys and Surface Finishes:**
  Lead Free solders and surface finishes shall not be used for Space, Interceptor and Airborne hardware. For Ground & Sea mobile and Ground benign hardware, lead free must be submitted to the PMPCB with a detailed justification and risk analysis

  Suppliers shall ensure EEE and mechanical parts utilized in safety and mission critical designs meet the aforementioned requirements by developing an approach to minimize inadvertent use of lead-free parts, including specific inspection methods for detecting lead-free parts and/or flow down of requirements to lower level suppliers to ensure compliant parts.

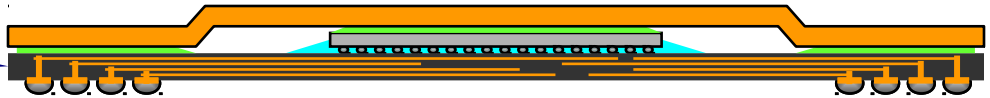
- **PMAP 3.2.7 Custom Devices:**
  Custom devices require a design review that includes verification that lead free has not been used in discrete devices contained within the Hybrid or ASIC.

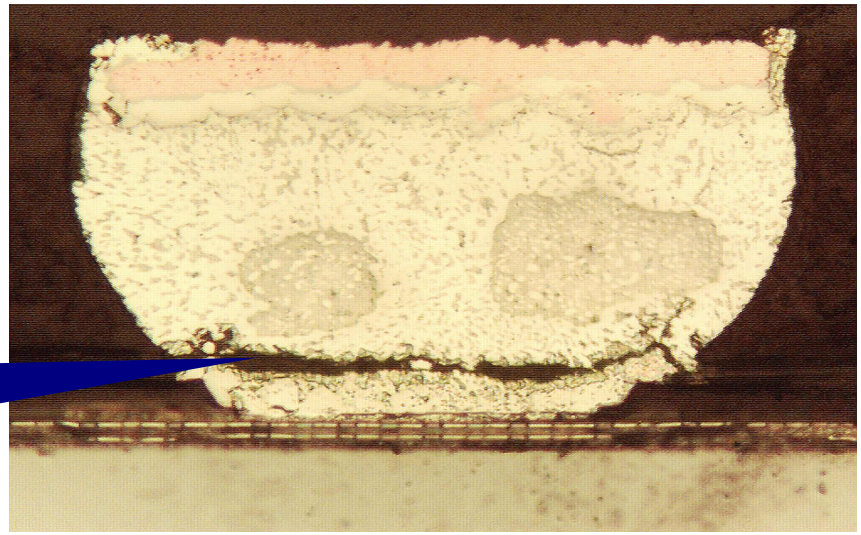
- **MDA currently participating in various lead-free studies and discussions**
  - **CALCE, GEIA, JEDEC**

PEMS in Military applications

- **Harsh environments and long term storage requirements of several MDA systems requires a robust approach for usage of PEMs:**

Flip Chip BGA PEM Package





Inside solder ball breakage from

PMAP Combating Misapplication of PEMS

- **PMAP 3.2.6 Plastic Encapsulated Microcircuits**
  - PEMs are permitted on MDA applications only when their use is necessary to achieve unique requirements that cannot be found in hermetic high reliability parts or where the application can tolerate less than the highest reliability part.

- **PMAP Appendix B PEM Screening and Qualification Requirements:**
  - PEMS shall be screened and qualified to meet their intended application. Specific PEM test plans, test flows and required device quantities are included in Appendix B.
  - The use of PEMs with a Moisture Sensitivity Level of greater than 4 is prohibited.

- **PMAP Appendix D Derating**
  - Specific derating requirements for PEMs are identified in Appendix A

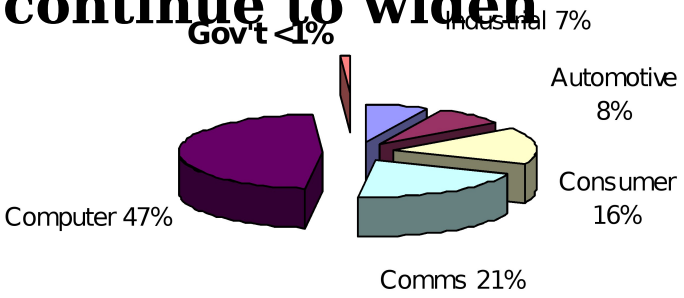
Worldwide Semiconductor Market

Military and Aerospace market share declined for 4½ Decades

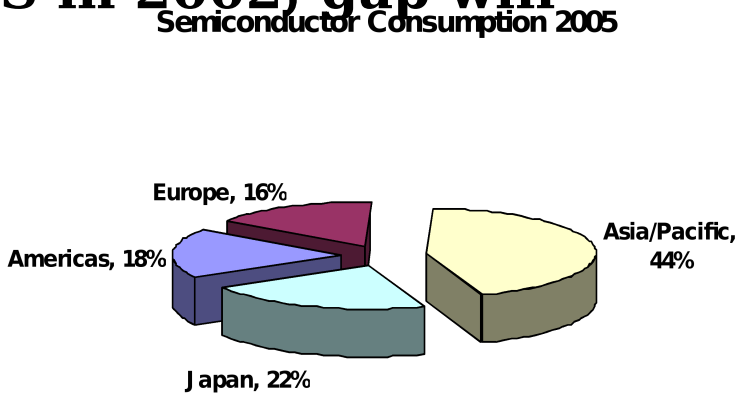
1995 = 1.6% 2002 = 0.5%

1994 Perry Directive accelerated COTS usage and further reduced Military IC demand

Asia-Pacific market surpassed US in 2002; gap will continue to widen



Source: Semiconductor Industry Association



Source: Isuppli, May 2006

PMAP Combating DMSMS

- **PMAP 3.6.15 Parts and Materials Obsolescence Plan:**
  Each Prime contractor's PMP Plan shall address the following:

  - Technology roadmaps shall be established to preclude "designing in" obsolescence.
  - An obsolescence surveillance process shall be established to maximize the opportunity for early identification of obsolescence through the use of GIDEP, Product Change Notification (PCN) subscription services, and other sources.
  - Obsolescence health assessments to minimize the obsolescence impacts shall be performed semi-annually throughout the life of the BMDS.
  - Assessment of mitigation options (alternate part, emulation, bridge buy, life-of-type buy) that consider program schedule, life cycle cost, and other appropriate factors.
  - Programs shall coordinate all obsolescence issues with the MDA PMPB to maximize cooperation for all programs under the MDA.
  - A case shall be set up for each obsolescence issue and the mitigation plan, tasks, schedule and status shall be tracked to closure.

Traceability

- **To respond to counterfeit issues, GIDEP Alerts, stock sweeps, pedigree reviews, etc, developers need to know everything about a part and material**
  - Where did it come from? (safety critical)
  - When did it come from there?
  - Who brought it?
  - Where is it going ?
  - When will it get there ? (schedule critical)
  - Where is it now ?
  - Who has it ?
  - What condition is it in? (cost critical)

PMAP Combating Traceability issues

- **PMAP 3.6.4 Electronic Parts Traceability:**
  - The developer shall develop and maintain traceability and lot control for all EEE parts, including COTS.
  - All EEE parts shall have 100% lot traceability to the production lot.

- **PMAP 3.6.5 Mechanical Parts Traceability**
  - One hundred percent (100%) lot traceability is required for machined mechanical parts used in mission and safety critical applications in space, interceptor and airborne hardware

- **PMAP 3.6.6 Materials Traceability**
  - For space, interceptor and airborne hardware, all materials shall be traceable to manufacturer and production lot or date code. Documentation shall be in place to provide bi-directional traceability of materials from receipt to the highest assembly level.

PMAP status and Path Forward

- **October ‘06: PMAP comment assessment conference**
  - **145 comments incorporated into Draft June 2006 PMAP**
- **20 October ‘06**
  - **EMC held with concurrence pending MDA Director’s signature**
- **Road show planned for 2007**
  - **Travel to Prime Contractors briefing PMAP, clarifying implementation of MDA PMP Hi-Rel program**

Backup Slides

END